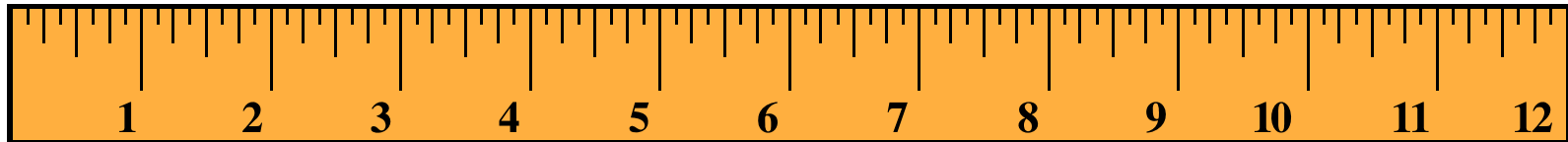


Units of Measurement and Conversion

Measurement

- A measurement tells us about a property of something



Why is measurement important?

- Measurement develops knowledge
 - It provides the information we need
- Measurement protects people
 - Collecting data to keep us safe
- Measurement governs transactions
 - Trade and commerce

Errors in Measurement

- Accuracy
 - Accuracy is how close a measured value is to the actual (true) value
- Accuracy depends on the instrument you are measuring with.

- Precision

- Precision is how close the measured values are to each other
- A measurement that has high precision has good repeatability



low accuracy
but high precision



Higher accuracy
but low precision



High accuracy and
high precision

Units

- Physical quantity
 - Physical property that can be quantified by measurement
- Unit
 - A definite magnitude of a physical quantity, defined and adopted by convention or by law, that is used as a standard for measurement of the same physical quantity



Systems of Measurement

- Traditional Systems

- Many systems were based on the use of parts of the body and the natural surrounds as measuring instruments
- As a result, units of measure could vary not only from location to location, but from person to person
- Ancient Roman units:

Roman Unit	English Name	English Equivalent	Metric Equivalent
digitus	finger	0.0607 ft	18.5 mm
pollex	thumb	0.0809 ft	24.6 mm
palmus	palm width	0.243 ft	74 mm
cubit	Cubit (forearm)	1.456 ft	444 mm

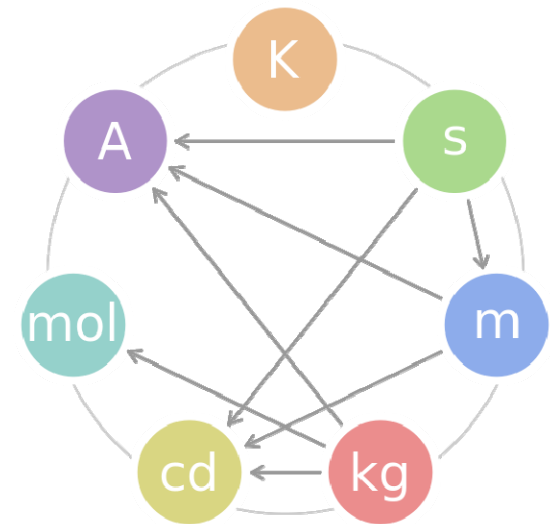
US Customary System

- Also known as American or Standard units
- The most commonly used system of measurement in the United States
- The U.S. customary units have common roots with the Imperial units, which were used in the British Empire
- The U.S. primarily uses customary units in its commercial activities

International System of Units (SI)

- The SI (Système International d'Unités) is a globally agreed system of units, with seven base units

Quantity	SI Unit	Symbol	Example
Length	meter	m	Height of double-decker bus: about 4.5 m
Mass	kilogram	kg	Large loaf of bread: about 0.8 kg
Time	second	s	Time between heart-beats (at rest): about 0.8 s
Electric current	ampere	A	Kettle: about 10 A
Temperature	kelvin	K	Human body: about 310 K
Luminous intensity	candela	cd	Candle: about 1 cd
Amount of substance	mole	mol	Water molecules in a cupful: about 14 mol



Standard \leftrightarrow SI

- Converting standard units to metric and vice versa
- Example: Convert 3 meters to feet (3 m to ft.)
 1. Think of what unit system you are converting to
 2. Find the conversion factor
 3. Think of it as multiplying fractions

$$3\text{ m} * \frac{3.28\text{ ft}}{1\text{ m}} \rightarrow \frac{3\text{ m} * 3.28\text{ ft}}{1\text{ m}} \rightarrow \frac{3\cancel{\text{ m}} * 3.28\text{ ft}}{1\cancel{\text{ m}}} = 9.84\text{ ft}$$

Practice

- 4 m = _____ ft.
- 5 in = _____ cm
- 235 kg = _____ lbs.
- 64 oz. = _____ g
- 20 gal. = _____ L

Challenge: Convert the following Measurements

- 12 in = _____ cm
- 235 lbs. = _____ kg
- 42 g = _____ oz.
- 5 gal. = _____ L
- 10 m = _____ in
- 212 °F = _____ °C
- 20 m = _____ ft.
- 0 °C = _____ °F
- At what temperature is degrees Fahrenheit and Celsius the same?

Answers

- 12 in = 30.48 cm
- 235 lbs. = 106.6 kg
- 42 g = 1.48 oz.
- 5 gal. = 18.9 L
- 10 m = 394 in
- 212 °F = 100 °C
- 20 m = 65.6 ft.
- 0 °C = 32 °F
- At what temperature is degrees Fahrenheit and Celsius the same?
 - $^{\circ}\text{C} = (^{\circ}\text{C} * 9/5) + 32$
 $^{\circ}\text{C} - (^{\circ}\text{C} * 9/5) = 32$
 $-4/5 * ^{\circ}\text{C} = 32$
 $^{\circ}\text{C} = -32 * 5/4$
 $^{\circ}\text{C} = -40$
 - $^{\circ}\text{F} = (^{\circ}\text{F} * 9/5) + 32$
 $^{\circ}\text{F} - (^{\circ}\text{F} * 9/5) = 32$
 $-4/5 * ^{\circ}\text{F} = 32$
 $^{\circ}\text{F} = -32 * 5/4$
 $^{\circ}\text{F} = -40$

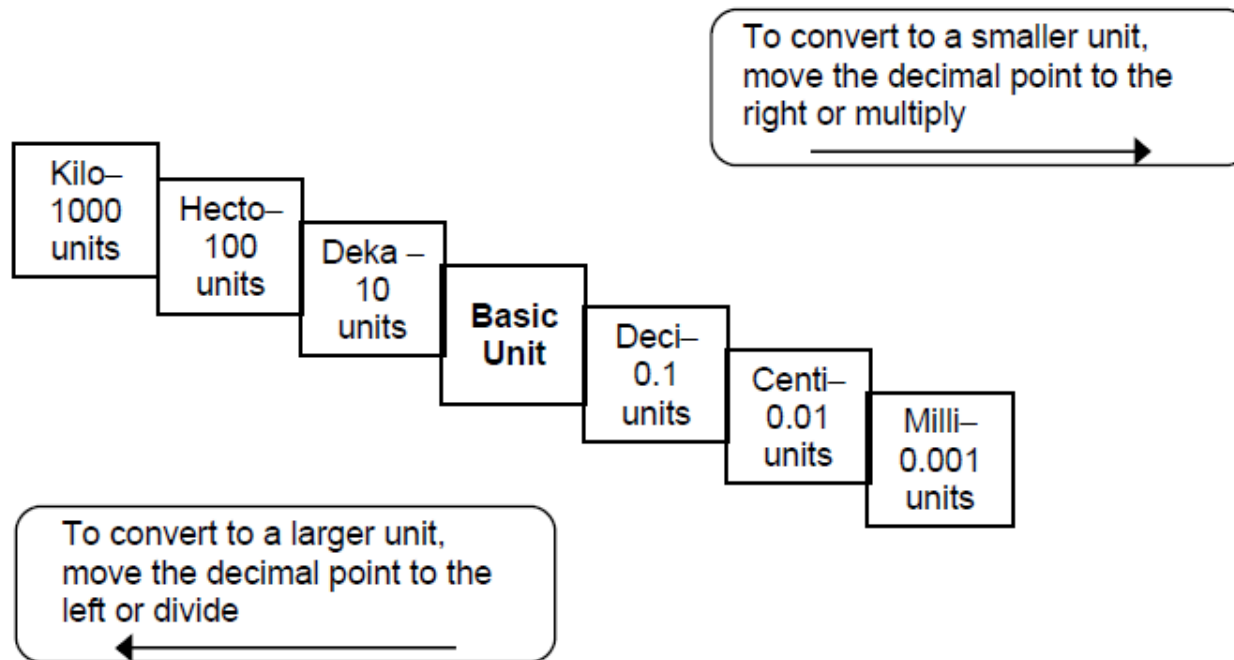
SI Prefixes

- SI prefixes are used to form decimal multiples and submultiples of SI units
- The prefix attaches directly to the name of a unit, and a prefix symbol attaches directly to the symbol for a unit

	Prefix	Number	Abbreviation
Larger	kilo	1,000	k
	hecto	100	h
	deka (deca)	10	dk (da)
Base Unit	meter/liter/gram	1	m/L/g
	deci	0.1	d
	centi	0.01	c
Smaller	milli	0.001	m

SI \leftrightarrow SI (Metric \leftrightarrow Metric)

- **King Henry Died By Drinking Chocolate Milk**



Practice

- 15 g = _____ mg
- 2 L = _____ ml
- 200 mg = _____ g
- 30 mm = _____ cm
- 10 km = _____ m

- 15 g = 15000 mg
- 2 L = 2000 ml
- 200 mg = 0.2 g
- 30 mm = 3 cm
- 10 km = 1000 m